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(54) LUBRICANT OIL FOR BEARING

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a lubricant oil for bearings that has excellent oxidation resistance, vaporization resistance and abrasive resistance.
SOLUTION: The objective lubricant oil for bearings is suitably used in the bearings with the shaft diameter of 0.5–1,000 mm and includes a synthetic oil with a kinematic viscosity of 1.0–100.0 mm²/s at 100° C and a viscosity index of ≥100.

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CLAIMS

[Claim(s)]

[Claim 1] The lubricating oil for bearing which an axial diameter is the lubricating oil for bearing used for the bearing which is 0.5–1000mm, and is characterized by for kinematic viscosity containing at 100 degrees C, and a viscosity index containing 100 or more synthetic oil 1.0–100.0mm²/s.

[Claim 2] (A) 0.05 to alkylation diphenylamine 2.0 mass %, (B) alkylation phenyl-alpha-naphthylamine 0.05 – 2.0 mass %, and ** -- the lubricating oil for bearing according to claim 1 characterized by containing at least one sort.

[Claim 3] (C) The lubricating oil for bearing according to claim 2 characterized by containing the FOSU fight 0.1 – 5.0 mass %.

[Claim 4] (D) The lubricating oil for bearing according to claim 2 or 3 characterized by containing phosphate 0.1 – 5.0 mass %.

[Claim 5] (E) The lubricating oil for bearing according to claim 2 to 4 characterized by the thing of benzotriazol and its derivative for which 0.001–0.05 mass % content of a kind is done at least.

[Claim 6] (F) The lubricating oil for bearing according to claim 2 to 5 characterized by containing the alkyl succinic-acid derivative 0.01 – 0.3 mass %.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] Especially this invention relates to the lubricating oil for bearing which is excellent in oxidation resistance, vaporization-proof, and abrasion resistance about the lubricating oil for bearing.

[0002]

[Background of the Invention] Conventionally, as a lubrication means of a device with an axial small diameter, it is common that grease is used. However, when a shaft rotates at high speed, with conventional grease, torque may become large, vibration of a shaft may become large, or the noise may come out.

[0003] Then, it is possible to use oil as a lubrication means of a bearing. However, even if it is the case where oil is used, depending on the class of base oil or additive, it may be easy to evaporate remarkably, or may be easy to oxidize. Especially, in precision machinery with an axial small diameter, since oil is exposed to a thin film condition, a thermal load is large and is used by the character top maintenance free in many cases. Therefore, the military requirement to oil has the oxidation stability which was excellent over the long period of time, and there is little evaporation and it becomes the outstanding lubrication engine performance which lessens wear of an ingredient as much as possible.

[0004]

[Objects of the Invention] In consideration of the above many points, this invention is a lubricating oil used for the bearing whose axial diameter is 0.5–1000mm, and aims at offering the lubricating oil which has outstanding oxidation resistance, vaporization-proof, and abrasion resistance.

[0005]

[Summary of the Invention] In order to attain the above-mentioned purpose, an axial diameter is the lubricating oil more preferably used for 0.5–50mm bearing 0.5–500mm preferably 0.5–1000mm, at 100 degrees C, kinematic viscosity makes 100 or more synthetic oil 1.0–100.0mm²/s, and a viscosity index makes base oil the lubricating oil for bearing of this invention, and it may consist of only this base oil. To this base oil, moreover, (A) alkylation diphenylamine 0.05 – 2.0 mass %, (B) Alkylation phenyl-alpha-naphthylamine 0.05 – 2.0 mass %, You may also include **** or both sides. To this further (C) FOSU fight 0.1 – 5.0 mass %, (D) Even if there are few phosphate 0.1 – 5.0 mass %s, (E) benzotriazols, and its derivatives, you may blend combining one or more kinds in kind 0.001–0.05 mass %, and (F) alkyl succinic-acid derivative 0.01 – 0.3 mass %.

[0006] the base oil in this invention -- the kinematic viscosity in 100 degrees C -- 1.0–100.0mm²/s -- desirable -- 1.25–40.0mm²/s -- further -- desirable -- 1.5–20.0mm²/s -- it is 1.75–10.0mm²/s especially preferably. If the kinematic viscosity in 100 degrees C is smaller than 1.0mm²/s, vaporization will get extremely bad, if larger than 100.0mm²/s, the starting torque of a shaft will become large and consumption of a power source will increase. moreover, a viscosity index -- 100 or more -- desirable -- 110–250 -- further -- desirable -- 115–250 -- it is 165–210 especially preferably. This viscosity index is JIS. It cannot measure by the approach of the

convention to K2283, and the expected engine performance cannot be obtained as a viscosity index is less than 100.

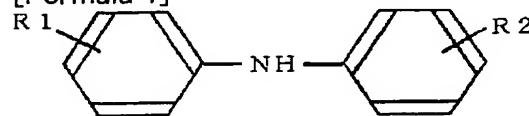
[0007] As synthetic oil (base oil) which has the above-mentioned property, ether oil; various, silicon oil; various fluorine oil; such as ester-oil; alkylation diphenyl ether, such as hydrocarbon system synthetic oil; monoester, diester, a polyol ester (trimethylol propane, pentaerythritol, dipentaerythritol, neopentyl diol ester, complex ester), polyglycol ester, glycerol ester, and aromatic series ester, the alkylation triphenyl ether, alkylation tetra-phenyl ether, and an alkylation polyphenyl ether, etc. is mentioned. These synthetic oil (base oil) may be used independently, and two or more sorts may be mixed and used for it.

[0008] As the above-mentioned hydrocarbon system synthetic oil, the Polly alpha olefin, polybutene, ethylene-alpha olefin oligomer, etc. are mentioned. As monoester, a caprylic acid, a capric acid, a lauric acid, a myristic acid, A palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, a lignoceric acid, etc., A methanol, ethanol, propanol, a butanol, a pentanol, The monoester which consists of univalent alcohol, such as a hexanol, heptanol, an octanol, nonanol, decanol, undeca Norian, a dodecanol, tridecanol, tetra-decanol, and PENTA decanol, is mentioned. The diester which consists of a malonic acid, a methylmalonic acid, a succinic acid, a methyl succinic acid, a dimethyl malonic acid, an ethyl malonic acid, a guru tongue acid, an adipic acid, a dimethyl succinic acid, a pimelic acid, a tetramethyl succinic acid, a suberic acid, an azelaic acid, a sebacic acid, a brasylic acid, etc. and the same above-mentioned univalent kind or the dibasic acid with different species of alcohol as diester is mentioned. As a polyol ester, the polyol ester which consists of trimethylolethane, trimethylol propane, pentaerythritol, a caprylic acid and a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, and a lignoceric acid is mentioned. As polyglycol ester, the glycol ester which consists of polyglycol, a caprylic acid and a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, and a lignoceric acid is mentioned. As glycerol ester, a mono-fatty-acid glycerol, a JI fatty-acid glycerol, and the Tori fatty-acid glycerol are mentioned, and, as for these fatty acids, a caprylic acid, a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, a lignoceric acid, etc. are mentioned. What a polyphenyl ether may not have an alkyl group and has the alkyl group of a straight chain or a branched chain may be used. These alkyl groups Methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl one, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, Ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, methyl octyl, ethyl PEPUCHIRU, n-DESHIRU, n-undecyl, n-dodecyl, n-tetradecyl, etc. are mentioned.

[0009] The lubricating oil for bearing of this invention may consist of the above synthetic oil (base oil), and may come to blend at least one sort of (C) - (F) component with the above synthetic oil with (A), the thing which comes to blend at least one sort of the (B) component or (A), and the (B) component. The alkylation diphenylamine which is this (A) component has the structure expressed with a bottom type.

[0010]

[Formula 1]



[0011] the inside of an upper type, and R1 and R2 -- a hydrogen atom or carbon numbers 1-16 -- more -- desirable -- carbon numbers 3-9 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 4 or 8 especially preferably. Since the solubility to an oil may

fall when the carbon number of an alkyl group exceeds 16, it is not desirable. R1-R2 may be the same, or they may differ. As these alkyl groups, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, Neopentyl one, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, methyl octyl, ethyl PEPUCHIRU, n-DESHIRU, n-undecyl, n-dodecyl, n-tetradecyl, etc. are mentioned.

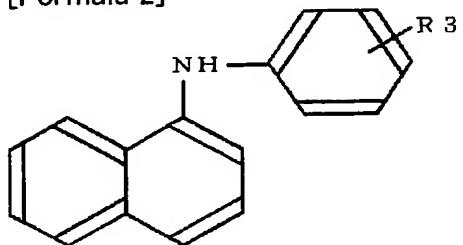
[0012] As a suitable example of the above-mentioned alkylation diphenylamine, a diphenylamine, a butyl diphenylamine, an octyl diphenylamine, a dibutyl diphenylamine, an octyl butyl diphenylamine, a dioctyl diphenylamine, etc. are mentioned. An alkylation diphenylamine may carry out independent use of the one sort, and may use two or more sorts together.

[0013] the blending ratio of coal of an alkylation diphenylamine -- 0.05 to 2.0 mass % -- desirable -- 0.05 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidantizing ability (oxidation stability) sufficient by under 0.05 mass % may not be obtained and it exceeds 2.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0014] (B) The alkylation phenyl-alpha-naphthylamine of a component has the structure expressed with a bottom type.

[0015]

[Formula 2]



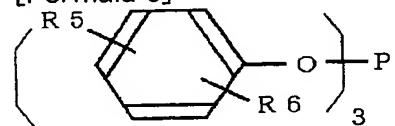
[0016] the inside of an upper type, and R3 -- carbon numbers 1-16 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 4-8 more preferably. As R3, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, Ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, i-octyl, t-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, i-nonyl, 1-methyl octyl, ethyl heptyl, n-DESHIRU, 1-methyl nonyl, n-undecyl, 1, and 1-dimethyl nonyl, n-dodecyl, n-tetradecyl, etc. are mentioned. As an example of the above-mentioned alkylation phenyl-alpha-naphthylamine, an n-pentyl-ized phenyl-alpha-naphthylamine, a 2-methylbutyl-ized phenyl-alpha-naphthylamine, a 2-ethylhexyl-ized phenyl-alpha-naphthylamine, an n-octyl-ized phenyl-alpha-naphthylamine, an n-nonyl-ized phenyl-alpha-naphthylamine, a 1-methyl octyl-ized phenyl-alpha-naphthylamine, an n-undecyl-ized phenyl-alpha-naphthylamine, and an n-dodecyl-ized phenyl-alpha-naphthylamine are mentioned. An alkylation phenyl-alpha-naphthylamine may carry out independent use of the one sort, and may use two or more sorts together.

[0017] the blending ratio of coal of an alkylation phenyl-alpha-naphthylamine -- 0.05 to 2.0 mass % -- desirable -- 0.1 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidantizing ability (oxidation stability) sufficient by under 0.05 mass % may not be obtained and it exceeds 2.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0018] (C) The FOSU fight of a component has the structure expressed with a bottom type.

[0019]

[Formula 3]



[0020] the inside of an upper type, and R5 and R6 -- carbon numbers 1-20 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 2-6 more preferably. As R5 and R6, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, Neopentyl one,

t-pentyl, 2-methylbutyl, n-octyl, i-hexyl, 3-methyl pentyl, ethyl butyl, heptyl, 2-methyl hexyl, n-octyl, i-octyl, t-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, i-nonyl, 1-methyl octyl, Ethyl heptyl, n-DESHIRU, 1-methyl nonyl, n-undecyl, 1 and 1-dimethyl nonyl, n-dodecyl, i-dodecyl, n-tridecyl, i-tridecyl, n-tetradecyl, i-tetradecyl, n-pentadecyl, i-pentadecyl, n-hexadecyl, i-hexadecyl, n-heptadecyl, i-heptadecyl, n-octadecyl, i-octadecyl, n-nona DESHIRU, i-nona DESHIRU, etc. are mentioned. These FOSU fights may carry out independent use of the one sort, and may use two or more sorts together.

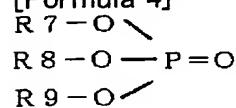
[0021] As an example of the above-mentioned FOSU fight, phosphorous acid trialkyl ester, such as a tris (2-ethylhexyl-3-mercaptopropionate) FOSU fight, a triphenyl FOSU fight, a trio KUTADESHIRUFOSU fight, a tris TEARIRUFOSU fight, the TORII soak CHIRUFOSU fight, a tris (nonylphenyl) FOSU fight, tricresyl phosphite, and a diphenyl isodecyl FOSU fight, phosphorous acid dialkyl ester, and phosphorous acid monoalkyl ester are mentioned.

[0022] the blending ratio of coal of a FOSU fight -- 0.1 to 5.0 mass % -- desirable -- 0.1 to 3.0 mass % -- especially -- desirable -- 0.1 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidantizing ability (oxidation stability) sufficient by under 0.1 mass % may not be obtained and it exceeds 5.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0023] (D) As phosphate of a component, it is the thing of the structure expressed with a bottom type [4].

[0024]

[Formula 4]



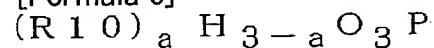
[0025] Among a formula, R7-R9 show hydrogen or the alkyl group of carbon numbers 1-20, an alkenyl radical, an alkyl aryl radical, or an arylated alkyl radical, may be the same or may differ. Preferably, it is the alkyl group of carbon numbers 3-18. When a carbon number exceeds 20, the solubility to an oil may fall.

[0026] There are thoria reel phosphate, trialkyl phosphate, etc. in the example of the above-mentioned phosphate. For example, benzyl diphenyl phosphate, allyl compound diphenyl phosphate, Triphenyl phosphate, tricresyl phosphate, ethyl diphenyl phosphate, Tributyl phosphate, ethyl dibutyl phosphate, cresyl diphenyl phosphate, Dicresyl phenyl phosphate, ethyl phenyl diphenyl phosphate, Diethyl phenyl phenyl phosphate, propyl phenyl diphenyl phosphate, Dipropyl phenyl phenyl phosphate, triethyl phenyl phosphate, Compounds, such as TORIPURO pill phenyl phosphate, butylphenyl diphenyl phosphate, dibutyl phenyl phenyl phosphate, and tributyl phenyl phosphate, can be mentioned.

[0027] Moreover, the acid phosphate of the structure expressed with a bottom type [5] is sufficient as phosphate.

[0028]

[Formula 5]



[0029] R10 expresses a with a carbon numbers of eight or more hydrocarbon group among a formula, and a is 1 or 2. As an example of R10, the saturation of the straight chain of carbon numbers 8-20 or a branched chain or the aliphatic hydrocarbon radical of partial saturation, i.e., an alkyl group, an alkenyl radical, the aromatic hydrocarbon radical of carbon numbers 8-26, and a cycloalkyl radical are mentioned. If abrasion resistance of a carbon number is not enough at less than eight and it exceeds 26, it will be hard coming to dissolve in base oil. a carbon number -- desirable -- 8-20 -- they are carbon numbers 8-18 more preferably.

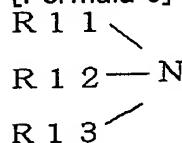
[0030] The examples of acid phosphate are 2-ethylhexyl acid phosphate; i-DESHIRU acid phosphate, lauryl acid phosphate, tridecyl acid phosphate, stearyl acid phosphate, i-stearyl acid phosphate, oleyl acid phosphate, di(2-ethylhexyl) phosphate, etc.

[0031] When making the above-mentioned acid phosphate contain, the alkylamine which

neutralizes with this and bonds a salt may be contained, and the alkylamine of the structure expressed with a bottom type [6] is mentioned as this amine further again.

[0032]

[Formula 6]



[0033] R11, R12, and R13 are the hydrocarbon groups or hydrogen atoms of monovalence among a formula, among those at least one piece is a hydrocarbon group.

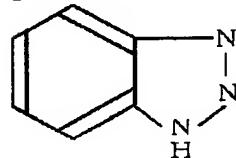
[0034] The examples of the above-mentioned alkylamine are dibutyl amine, an octyl amine, a dioctyl amine, a lauryl amine, a dilauryl amine, an oleyl amine, a coconut amine, a beef tallow amine, etc.

[0035] In addition, the phosphate as above (D) components may carry out independent use of the one sort, and it may use two or more sorts together. moreover, the blending ratio of coal of the phosphate of the (D) component -- 0.1 - 5 mass % -- desirable -- 0.3 - 3 mass % -- further -- desirable -- 0.5 - 2 mass % -- it is 0.7 - 1.5 mass % especially preferably. If sufficient extreme pressure engine performance (wear-resistant ability) cannot be obtained with it being under 0.1 mass % but 5 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0036] (E) The benzotriazol of a component and its derivative are benzotriazol with the structure expressed with a bottom type [7], and a derivative obtained in response to it in a water-soluble amine, fatty acid ester, etc. These benzotriazol and its derivative may carry out independent use of the one sort, and may use two or more sorts together.

[0037]

[Formula 7]

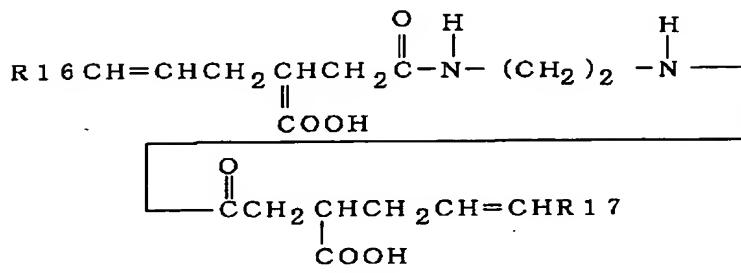
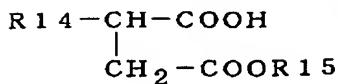


[0038] (E) the benzotriazol of a component, and the blending ratio of coal of the derivative -- 0.001 to 0.05 mass % -- it is 0.003 to 0.02 mass % preferably. If it is under 0.1 mass %, sufficient metallic corrosion tightness cannot be acquired, and if 0.05 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0039] (F) As an alkyl succinic-acid derivative of a component, an alkyl succinic-acid amide, alkyl succinate, etc. are mentioned, and the suitable thing of the derivative of an alkyl succinic acid has the structure expressed with a bottom type [8].

[0040]

[Formula 8]



[0041] R14, R16, and R17 are the alkyl groups or alkenyl radicals of carbon numbers 6–18 among the two above-mentioned formulas, and R15 shows a hydrogen atom or the alkyl group of carbon numbers 1–5. R15 is the alkenyl radical of carbon numbers 10–14 preferably, and is dodecetyl one or dodecadienyl especially preferably. R16 and R17 are the alkyl groups or alkenyl radicals of carbon numbers 8–16 preferably. Hexyl, octyl, nonyl, DESHIRU, undecyl, dodecyl, tetradecyl, heptadecyl, octadecyl, hexenyl one, OKUTENIRU, NONENIRU, decenyl, undecenyl, dodecenyl one, tetra-decenyl, heptadecenyl, octadecenyl, HEKISE dienyl, OKUTA dienyl, nona dienyl, deca dienyl, undeca dienyl, dodecadienyl, tetra-deca dienyl, heptadeca dienyl, octadecadienyl, etc. are mentioned as an example of R14, R16, and R17. As an example of R15, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl one, t-pentyl, 2-methylbutyl, etc. are mentioned.

[0042] Although these alkyl succinic-acid derivatives may carry out independent use of the one sort and may use two or more sorts together, they are two or more sorts of concomitant use preferably, and are concomitant use of the partial ester of an alkenyl succinic acid, and an alkyl succinic-acid amide especially preferably.

[0043] (F) the blending ratio of coal of the alkyl succinic-acid derivative of a component -- 0.01 to 0.3 mass % -- desirable -- 0.03 to 0.1 mass % -- it is 0.03 to 0.07 mass % especially preferably. If it is under 0.01 mass %, sufficient metallic corrosion tightness may not be acquired, and if 0.3 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0044] The lubricating oil for bearing of this invention blends each above-mentioned component with the synthetic oil which is base oil, and especially the base oil in the case of blending, and the mixed approach or the addition approach of each component cannot be restricted, can be performed by various approaches, and can also perform a mixed sequence foreword and addition sequence by various approaches. For example, sequential addition of each component may be carried out at base oil, each component is mixed beforehand, and you may add to synthetic oil. Furthermore, the lubricating oil for bearing of this invention can raise vaporization-proof by doubling the - (F) component (above-mentioned [A]), and adding.

[0045]

[Example] (A) – (F) component was blended with base oil, the lubricating oil for bearing was prepared, and the example and the example of a comparison estimated each oxidation resistance, vaporization-proof, and abrasion resistance. The base oil and each component which were used in each example and each example of a comparison are as follows.

[0046] (Base oil)

** It is mineral oil ** synthetic oil which carried out solvent extraction of the vacuum distillation distillate by the furfural with the paraffin series mineral oil by which advanced purification was carried out, and carried out hydrorefining further after the delow by the methyl ethyl ketone, and is oleic acid isobutyl ** synthetic oil, and the kinematic viscosity of all of the palmitic-acid octyl above-mentioned ** - ** is the thing of 1.5-4.0mm²/s within the limits at 100 degrees C.

[0047] In-izing 1 Alkylation phenylamine; (A component) R1 and R2 The mixture (B component) alkylation phenyl-alpha-naphthylamine of the combination of either the straight chain of a hydrogen atom, -C4H9, and -C8H17, or a branched chain; In-izing 2 In-izing 3 R3 -- alkylation phenyl-alpha-naphthylamine (C component) FOSU fight [of the straight chain of -C8H17, or a branched chain]; -- In-izing 4 R5 and R6 -- FOSU fight (D component) phosphate [of the straight chain of -C4H9, or a branched chain]; -- R7, R8, and R9 by the same alkyl group In-izing 8 top type the tricresyl phosphate (E component) benzotriazol of a carbon number 7, and derivative; -- benzotriazol (F component) alkyl succinic-acid derivative; shown by-izing 7 -- R14 is the alkyl group of a carbon number 12, and R15 is the alkyl succinic-acid derivative [0048] of the alkyl group of a carbon number 5. (The evaluation approach)

** The evaluation approach of oxidation stability <a sludge examination method>; it is based on the trial based on the oxidation stability test enacted by JISK2540 by one of the approaches which evaluates the antioxidant engine performance of a lubricating oil.

test condition: --- temperature; --- 170-degree-C time amount; --- evaluation approach <Noack of 12hr** vaporization --- law>; --- it is based on the vaporization trial enacted by JPI-5S-41-93 by one of the approaches which evaluates the vaporization of a lubricating oil.

** The lubricative evaluation approach <the shell walk examining method>; based on ASTMD2783, it carried out by one of the approaches which evaluates the lubricity of a lubricating oil, and the diameter of wear estimated lubricity.

試験条件：回転数 : 1200 rpm

荷重 : 30 kgf

試験時間 : 30 min

試験温度 : 室温

** The evaluation approach of the corrosion stability to a metal; based on JISK2513, it carried out by one of the approaches which evaluates the lubricity of a lubricating oil, and extent of discoloration of a copper plate estimated the corrosion stability to a metal. Extent of discoloration is evaluated in 12 steps of 1a to 4c, and shows a result with most [extent / there is few extent of discoloration of 1a (corrosion stability is the best), and] (corrosion stability is the worst) extent of discoloration of 4c.

** The evaluation approach of rust-proofing nature; it carried out by the approach enacted to JISK2510 by one of the approaches which evaluates the rust-proofing nature of a lubricating oil, and extent of rust estimated rust-proofing nature. It estimated "with rust" extent of rust "had no rust", and, in the case of "with rust", evaluating by the advanced three-stage cost slightness and whenever [inside].

[0049] It blended at a rate (mass %) of hanging up one to example 6 base oil, A component, B component, C component, D component, E component, and F component over a Table 1 upper case, and the lubricating oil for bearing was prepared. The various engine performance of these lubricating oils is evaluated, and the result is shown in the Table 1 lower berth.

[0050] It blended at a rate (mass %) of hanging up one to example of comparison 2 base oil, A component, B component, C component, D component, E component, and F component over a Table 2 upper case, and the lubricating oil for bearing was prepared. The various engine performance of these lubricating oils is evaluated, and the result is shown in the Table 2 lower berth.

[0051]

[1 of Table 1]

	実施例 1	実施例 2	実施例 3	実施例 4
基油 ① ② ③	○	○	○	○
動粘度 100°C mm ² / s	2. 321	2. 321	2. 321	2. 321
粘度指数	205	205	205	205
添加成分 (質量%)				
(A) アルキル化ジフェニルアミン		0. 15	0. 15	0. 15
(B) アルキル化フェニル-α-ナフチルアミン		0. 25	0. 25	0. 25
(C) フオスファイト			0. 15	0. 15
(D) トリクレジルfosfate				0. 80
(E) ベンゾトリアゾール				
(F) アルキルコハク酸エステル				
スラッジ試験	析出物なし	析出物なし	析出物なし	析出物なし
Noack 重量減量 (質量%)	23. 2	19. 1	15. 9	15. 9
潤滑性 摩耗径 (mm)	0. 40	0. 40	0. 40	0. 31
銅板腐食 (121°C × 3時間)				
防錆性 (人工海水)				

[0052]
[2 of Table 1]

	実施例5	実施例6
基油 ① ② ③	○	○
動粘度 (100℃) mm ² / s	2. 321	2. 915
粘度指数	205	170
添加成分 (質量%)		
(A) アルキル化ジフェニルアミン	0. 15	0. 15
(B) アルキル化フェニル-α-ナフチルアミン	0. 25	0. 25
(C) フオスファイト	0. 15	0. 15
(D) トリクロレジルfosfate	0. 80	0. 80
(E) ベンゾトリアゾール	0. 004	0. 004
(F) アルキルコハク酸エステル	0. 04	0. 04
スラッジ試験	析出物なし	析出物なし
Noack 重量減量 (質量%)	15. 9	16. 2
潤滑性 摩耗径 (mm)	0. 31	0. 31
銅板腐食 (121℃ × 3時間)	1a	1a
防錆性 (人工海水)	錆なし	錆なし

[0053]

[Table 2]

	比較例 1	比較例 2
基油 ① ② ③	○	○
動粘度 (100℃) mm ² / s	2. 586	2. 586
粘度指数	86	86
添加成分 (質量%)		
(A) アルキル化ジフェニルアミン		0. 15
(B) アルキル化フェニル- α -ナフチルアミン		0. 25
(C) フオスファイト		0. 15
(D) トリクレジルfosfate		0. 80
(E) ベンゾトリアゾール		0. 004
(F) アルキルコハク酸エステル		0. 04
スラッジ試験	析出物あり	析出物あり
Noack 重量減量 (質量%)	34. 3	33. 8
潤滑性 摩耗径 (mm)	0. 67	0. 49
鋼板腐食 (121℃×3時間)		1a
防錆性 (人工海水)		錆なし

[0054]

[Effect of the Invention] The lubricating oil for bearing of this invention is excellent in oxidation resistance, vaporization-proof, and abrasion resistance, and an axial diameter can use it suitable for the bearing of an axial diameter with 0.5-1000mm and a shaft to a wide range thin thick shaft.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the lubricating oil for bearing which is excellent in oxidation resistance, vaporization-proof, and abrasion resistance about the lubricating oil for bearing.

[0002]

[Background of the Invention] Conventionally, as a lubrication means of a device with an axial small diameter, it is common that grease is used. However, when a shaft rotates at high speed, with conventional grease, torque may become large, vibration of a shaft may become large, or the noise may come out.

[0003] Then, it is possible to use oil as a lubrication means of a bearing. However, even if it is the case where oil is used, depending on the class of base oil or additive, it may be easy to evaporate remarkably, or may be easy to oxidize. Especially, in precision machinery with an axial small diameter, since oil is exposed to a thin film condition, a thermal load is large and is used by the character top maintenance free in many cases. Therefore, the military requirement to oil has the oxidation stability which was excellent over the long period of time, and there is little evaporation and it becomes the outstanding lubrication engine performance which lessens wear of an ingredient as much as possible.

[0004]

[Objects of the Invention] In consideration of the above many points, this invention is a lubricating oil used for the bearing whose axial diameter is 0.5–1000mm, and aims at offering the lubricating oil which has outstanding oxidation resistance, vaporization-proof, and abrasion resistance.

[0005]

[Summary of the Invention] In order to attain the above-mentioned purpose, an axial diameter is the lubricating oil more preferably used for 0.5–50mm bearing 0.5–500mm preferably 0.5–1000mm, at 100 degrees C, kinematic viscosity makes 100 or more synthetic oil 1.0–100.0mm²/s, and a viscosity index makes base oil the lubricating oil for bearing of this invention, and it may consist of only this base oil. To this base oil, moreover, (A) alkylation diphenylamine 0.05 – 2.0 mass %, (B) Alkylation phenyl-alpha-naphthylamine 0.05 – 2.0 mass %, You may also include ***** or both sides. To this further (C) FOSU fight 0.1 – 5.0 mass %, (D) Even if there are few phosphate 0.1 – 5.0 mass %s, (E) benzotriazols, and its derivatives, you may blend combining one or more kinds in kind 0.001–0.05 mass %, and (F) alkyl succinic-acid derivative 0.01 – 0.3 mass %.

[0006] the base oil in this invention -- the kinematic viscosity in 100 degrees C -- 1.0–100.0mm²/s -- desirable -- 1.25–40.0mm²/s -- further -- desirable -- 1.5–20.0mm²/s -- it is 1.75–10.0mm²/s especially preferably. If the kinematic viscosity in 100 degrees C is smaller than 1.0mm²/s, vaporization will get extremely bad, if larger than 100.0mm²/s, the starting torque of a shaft will become large and consumption of a power source will increase. moreover, a viscosity index -- 100 or more -- desirable -- 110–250 -- further -- desirable -- 115–250 -- it is 165–210 especially preferably. This viscosity index is JIS. It cannot measure by the approach of the convention to K2283, and the expected engine performance cannot be obtained as a viscosity index is less than 100.

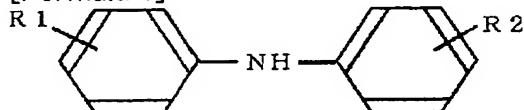
[0007] As synthetic oil (base oil) which has the above-mentioned property, ether oil; various, silicon oil; various fluorine oil; such as ester-oil; alkylation diphenyl ether, such as hydrocarbon system synthetic oil; monoester, diester, a polyol ester (trimethylol propane, pentaerythritol, dipentaerythritol, neopentyl diol ester, complex ester), polyglycol ester, glycerol ester, and aromatic series ester, the alkylation triphenyl ether, alkylation tetra-phenyl ether, and an alkylation polyphenyl ether, etc. is mentioned. These synthetic oil (base oil) may be used independently, and two or more sorts may be mixed and used for it.

[0008] As the above-mentioned hydrocarbon system synthetic oil, the Polly alpha olefin, polybutene, ethylene-alpha olefin oligomer, etc. are mentioned. As monoester, a caprylic acid, a capric acid, a lauric acid, a myristic acid, A palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, a lignoceric acid, etc., A methanol, ethanol, propanol, a butanol, a pentanol, The monoester which consists of univalent alcohol, such as a hexanol, heptanol, an octanol, nonanol, decanol, undeca Norian, a dodecanol, tridecanol, tetra-decanol, and PENTA decanol, is mentioned. The diester which consists of a malonic acid, a methylmalonic acid, a succinic acid, a methyl succinic acid, a dimethyl malonic acid, an ethyl malonic acid, a guru tongue acid, an adipic acid, a dimethyl succinic acid, a pimelic acid, a tetramethyl succinic acid, a suberic acid, an azelaic acid, a sebacic acid, a brasylic acid, etc. and the same above-mentioned univalent kind or the dibasic acid with different species of alcohol as diester is mentioned. As a polyol ester, the polyol ester which consists of trimethylolethane, trimethylol propane, pentaerythritol, a caprylic acid and a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, and a lignoceric acid is mentioned. As polyglycol ester, the glycol ester which consists of polyglycol, a caprylic acid and a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, and a lignoceric acid is mentioned. As glycerol ester, a mono-fatty-acid glycerol, a JI fatty-acid glycerol, and the Tori fatty-acid glycerol are mentioned, and, as for these fatty acids, a caprylic acid, a capric acid, a lauric acid, a myristic acid, a palmitic acid, palmitoleic acid, stearin acid, oleic acid, a ricinoleic acid, linolic acid, a linolenic acid, an arachidonic acid, icosapentaenoic acid, an erucic acid, docosa-hexaenoic acid, a lignoceric acid, etc. are mentioned. What a polyphenyl ether may not have an alkyl group and has the alkyl group of a straight chain or a branched chain may be used. These alkyl groups Methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl one, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, Ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, methyl octyl, ethyl PEPUCHIRU, n-DESHIRU, n-undecyl, n-dodecyl, n-tetradecyl, etc. are mentioned.

[0009] The lubricating oil for bearing of this invention may consist of the above synthetic oil (base oil), and may come to blend at least one sort of (C) - (F) component with the above synthetic oil with (A), the thing which comes to blend at least one sort of the (B) component or (A), and the (B) component. The alkylation diphenylamine which is this (A) component has the structure expressed with a bottom type.

[0010]

[Formula 1]



[0011] the inside of an upper type, and R1 and R2 -- a hydrogen atom or carbon numbers 1-16 -- more -- desirable -- carbon numbers 3-9 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 4 or 8 especially preferably. Since the solubility to an oil may fall when the carbon number of an alkyl group exceeds 16, it is not desirable. R1-R2 may be the same, or they may differ. As these alkyl groups, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl,

t-butyl, n-pentyl, i-pentyl, Neopentyl one, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, methyl octyl, ethyl PEPUCHIRU, n-DESHIRU, n-undecyl, n-dodecyl, n-tetradecyl, etc. are mentioned.

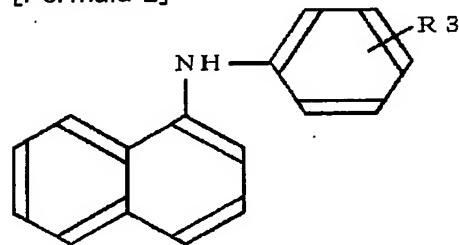
[0012] As a suitable example of the above-mentioned alkylation diphenylamine, a diphenylamine, a butyl diphenylamine, an octyl diphenylamine, a dibutyl diphenylamine, an octyl butyl diphenylamine, a dioctyl diphenylamine, etc. are mentioned. An alkylation diphenylamine may carry out independent use of the one sort, and may use two or more sorts together.

[0013] the blending ratio of coal of an alkylation diphenylamine -- 0.05 to 2.0 mass % -- desirable -- 0.05 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidanting ability (oxidation stability) sufficient by under 0.05 mass % may not be obtained and it exceeds 2.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0014] (B) The alkylation phenyl-alpha-naphthylamine of a component has the structure expressed with a bottom type.

[0015]

[Formula 2]



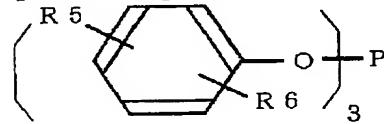
[0016] the inside of an upper type, and R3 -- carbon numbers 1-16 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 4-8 more preferably. As R3, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, Ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, i-octyl, t-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, i-nonyl, 1-methyl octyl, ethyl heptyl, n-DESHIRU, 1-methyl nonyl, n-undecyl, 1, and 1-dimethyl nonyl, n-dodecyl, n-tetradecyl, etc. are mentioned. As an example of the above-mentioned alkylation phenyl-alpha-naphthylamine, an n-pentyl-ized phenyl-alpha-naphthylamine, a 2-methylbutyl-ized phenyl-alpha-naphthylamine, a 2-ethylhexyl-ized phenyl-alpha-naphthylamine, an n-octyl-ized phenyl-alpha-naphthylamine, an n-nonyl-ized phenyl-alpha-naphthylamine, a 1-methyl octyl-ized phenyl-alpha-naphthylamine, an n-undecyl-ized phenyl-alpha-naphthylamine, and an n-dodecyl-ized phenyl-alpha-naphthylamine are mentioned. An alkylation phenyl-alpha-naphthylamine may carry out independent use of the one sort, and may use two or more sorts together.

[0017] the blending ratio of coal of an alkylation phenyl-alpha-naphthylamine -- 0.05 to 2.0 mass % -- desirable -- 0.1 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidanting ability (oxidation stability) sufficient by under 0.05 mass % may not be obtained and it exceeds 2.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0018] (C) The FOSU fight of a component has the structure expressed with a bottom type.

[0019]

[Formula 3]



[0020] the inside of an upper type, and R5 and R6 -- carbon numbers 1-20 -- it is the alkyl group of the straight chain or branched chain of carbon numbers 2-6 more preferably. As R5 and R6, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, Neopentyl one, t-pentyl, 2-methylbutyl, n-hexyl, i-hexyl, 3-methyl pentyl, ethyl butyl, n-heptyl, 2-methyl hexyl, n-octyl, i-octyl, t-octyl, 2-ethylhexyl, 3-methyl heptyl, n-nonyl, i-nonyl, 1-methyl octyl, Ethyl

heptyl, n-DESHIRU, 1-methoxyethyl, n-undecyl, 1 and 1-dimethyl nonyl, dodecyl, i-dodecyl, n-tridecyl, i-tridecyl, n-tetradecyl, i-tetradecyl, n-pentadecyl, i-pentadecyl, n-hexadecyl, i-hexadecyl, n-heptadecyl, i-heptadecyl, n-octadecyl, i-octadecyl, n-nona DESHIRU, i-nona DESHIRU, etc. are mentioned. These FOSU fights may carry out independent use of the one sort, and may use two or more sorts together.

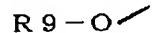
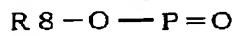
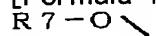
[0021] As an example of the above-mentioned FOSU fight, phosphorous acid trialkyl ester, such as a tris (2-ethylhexyl-3-mercaptopropionate) FOSU fight, a triphenyl FOSU fight, a trio KUTADESHIRUFOSU fight, a tris TEARIRUFOSU fight, the TORII soak CHIRUFOSU fight, a tris (nonylphenyl) FOSU fight, tricresyl phosphite, and a diphenyl isodecyl FOSU fight, phosphorous acid dialkyl ester, and phosphorous acid monoalkyl ester are mentioned.

[0022] the blending ratio of coal of a FOSU fight -- 0.1 to 5.0 mass % -- desirable -- 0.1 to 3.0 mass % -- especially -- desirable -- 0.1 to 1.0 mass % -- it is 0.1 to 0.5 mass % still more preferably. Even if antioxidantizing ability (oxidation stability) sufficient by under 0.1 mass % may not be obtained and it exceeds 5.0 mass %, effectiveness is saturated, and it becomes disadvantageous economically.

[0023] (D) As phosphate of a component, it is the thing of the structure expressed with a bottom type [4].

[0024]

[Formula 4]



[0025] Among a formula, R7-R9 show hydrogen or the alkyl group of carbon numbers 1-20, an alkenyl radical, an alkyl aryl radical, or an arylated alkyl radical, may be the same or may differ. Preferably, it is the alkyl group of carbon numbers 3-18. When a carbon number exceeds 20, the solubility to an oil may fall.

[0026] There are thoria reel phosphate, trialkyl phosphate, etc. in the example of the above-mentioned phosphate. For example, benzyl diphenyl phosphate, allyl compound diphenyl phosphate, Triphenyl phosphate, tricresyl phosphate, ethyl diphenyl phosphate, Tributyl phosphate, ethyl dibutyl phosphate, cresyl diphenyl phosphate, Dicresyl phenyl phosphate, ethyl phenyl diphenyl phosphate, Diethyl phenyl phenyl phosphate, propyl phenyl diphenyl phosphate, Dipropyl phenyl phenyl phosphate, triethyl phenyl phosphate, Compounds, such as TORIPURO pill phenyl phosphate, butylphenyl diphenyl phosphate, dibutyl phenyl phenyl phosphate, and tributyl phenyl phosphate, can be mentioned.

[0027] Moreover, the acid phosphate of the structure expressed with a bottom type [5] is sufficient as phosphate.

[0028]

[Formula 5]



[0029] R10 expresses a with a carbon numbers of eight or more hydrocarbon group among a formula, and a is 1 or 2. As an example of R10, the saturation of the straight chain of carbon numbers 8-20 or a branched chain or the aliphatic hydrocarbon radical of partial saturation, i.e., an alkyl group, an alkenyl radical, the aromatic hydrocarbon radical of carbon numbers 8-26, and a cycloalkyl radical are mentioned. If abrasion resistance of a carbon number is not enough at less than eight and it exceeds 26, it will be hard coming to dissolve in base oil. a carbon number -- desirable -- 8-20 -- they are carbon numbers 8-18 more preferably.

[0030] The examples of acid phosphate are 2-ethylhexyl acid phosphate, i-DESHIRU acid phosphate, lauryl acid phosphate, tridecyl acid phosphate, stearyl acid phosphate, i-stearyl acid phosphate, oleyl acid phosphate, di(2-ethylhexyl) phosphate, etc.

[0031] When making the above-mentioned acid phosphate contain, the alkylamine which neutralizes with this and builds a salt may be contained, and the alkylamine of the structure expressed with a bottom type [6] is mentioned as this amine further again.

[0032]

[Formula 6]

R 1 1

R 1 2 — N

R 1 3

[0033] R11, R12, and R13 are the hydrocarbon groups or hydrogen atoms of monovalence among a formula, among those at least one piece is a hydrocarbon group.

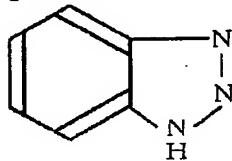
[0034] The examples of the above-mentioned alkylamine are dibutyl amine, an octyl amine, a dioctyl amine, a lauryl amine, a dilauryl amine, an oleyl amine, a coconut amine, a beef tallow amine, etc.

[0035] In addition, the phosphate as above (D) components may carry out independent use of the one sort, and it may use two or more sorts together. moreover, the blending ratio of coal of the phosphate of the (D) component -- 0.1 - 5 mass % -- desirable -- 0.3 - 3 mass % -- further -- desirable -- 0.5 - 2 mass % -- it is 0.7 - 1.5 mass % especially preferably. If sufficient extreme pressure engine performance (wear-resistant ability) cannot be obtained with it being under 0.1 mass % but 5 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0036] (E) The benzotriazol of a component and its derivative are benzotriazol with the structure expressed with a bottom type [7], and a derivative obtained in response to it in a water-soluble amine, fatty acid ester, etc. These benzotriazol and its derivative may carry out independent use of the one sort, and may use two or more sorts together.

[0037]

[Formula 7]



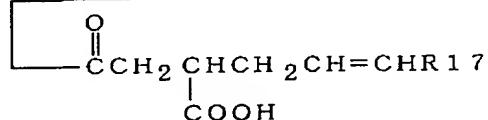
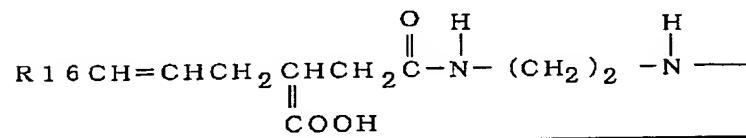
[0038] (E) the benzotriazol of a component, and the blending ratio of coal of the derivative -- 0.001 to 0.05 mass % -- it is 0.003 to 0.02 mass % preferably. If it is under 0.1 mass %, sufficient metallic corrosion tightness cannot be acquired, and if 0.05 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0039] (F) As an alkyl succinic-acid derivative of a component, an alkyl succinic-acid amide, alkyl succinate, etc. are mentioned, and the suitable thing of the derivative of an alkyl succinic acid has the structure expressed with a bottom type [8].

[0040]

[Formula 8]

R 1 4 — CH — COOH

CH₂ — COOR 1 5

[0041] R14, R16, and R17 are the alkyl groups or alkenyl radicals of carbon numbers 6-18 among the two above-mentioned formulas, and R15 shows a hydrogen atom or the alkyl group of carbon numbers 1-5. R15 is the alkenyl radical of carbon numbers 10-14 preferably, and is dodecetyl one or dodecadienyl especially preferably. R16 and R17 are the alkyl groups or alkenyl radicals of carbon numbers 8-16 preferably. Hexyl, octyl, nonyl, DESHIRU, undecyl, dodecyl, tetradecyl, heptadecyl, octadecyl, hexenyl one, OKUTENIRU, NONENIRU, decenyl, undecenyl, dodecenyl one, tetra-decenyl, heptadecenyl, octadecenyl, HEKISE dienyl, OKUTA dienyl, nona dienyl, deca dienyl, undeca dienyl, dodecadienyl, tetra-deca dienyl, heptadeca dienyl, octadecadienyl, etc. are mentioned as an example of R14, R16, and R17. As an example of R15, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, neopentyl one, t-pentyl, 2-methylbutyl, etc. are mentioned.

[0042] Although these alkyl succinic-acid derivatives may carry out independent use of the one sort and may use two or more sorts together, they are two or more sorts of concomitant use preferably, and are concomitant use of the partial ester of an alkenyl succinic acid, and an alkyl succinic-acid amide especially preferably.

[0043] (F) the blending ratio of coal of the alkyl succinic-acid derivative of a component -- 0.01 to 0.3 mass % -- desirable -- 0.03 to 0.1 mass % -- it is 0.03 to 0.07 mass % especially preferably. If it is under 0.01 mass %, sufficient metallic corrosion tightness may not be acquired, and if 0.3 mass % is exceeded, effectiveness will be saturated and it will become disadvantageous economically.

[0044] The lubricating oil for bearing of this invention blends each above-mentioned component with the synthetic oil which is base oil, and especially the base oil in the case of blending, and the mixed approach or the addition approach of each component cannot be restricted, can be performed by various approaches, and can also perform a mixed sequence foreword and addition sequence by various approaches. For example, sequential addition of each component may be carried out at base oil, each component is mixed beforehand, and you may add to synthetic oil. Furthermore, the lubricating oil for bearing of this invention can raise vaporization-proof by doubling the - (F) component (above-mentioned [A]), and adding.

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EFFECT OF THE INVENTION

[Effect of the Invention] The lubricating oil for bearing of this invention is excellent in oxidation resistance, vaporization-proof, and abrasion resistance, and an axial diameter can use it suitable for the bearing of an axial diameter with 0.5-1000mm and a shaft to a wide range thin thick shaft.

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EXAMPLE

[Example] (A) – (F) component was blended with base oil, the lubricating oil for bearing was prepared, and the example and the example of a comparison estimated each oxidation resistance, vaporization-proof, and abrasion resistance. The base oil and each component which were used in each example and each example of a comparison are as follows.

[0046] (Base oil)

** It is mineral oil ** synthetic oil which carried out solvent extraction of the vacuum distillation distillate by the furfural with the paraffin series mineral oil by which advanced purification was carried out, and carried out hydrorefining further after the delow by the methyl ethyl ketone, and is oleic acid isobutyl ** synthetic oil, and the kinematic viscosity of all of the palmitic-acid octyl above-mentioned ** – ** is the thing of 1.5–4.0mm²/s within the limits at 100 degrees C.

[0047] In-izing 1 Alkylation diphenylamine; (A component) R1 and R2 The mixture (B component) alkylation phenyl-alpha-naphthylamine of the combination of either the straight chain of a hydrogen atom, -C4H9, and -C8H17, or a branched chain; In-izing 2 In-izing 3 R3 — alkylation phenyl-alpha-naphthylamine (C component) FOSU fight [of the straight chain of -C8H17, or a branched chain]; — In-izing 4 R5 and R6 — FOSU fight (D component) phosphate [of the straight chain of -C4H9, or a branched chain]; — R7, R8, and R9 by the same alkyl group In a-izing 8 top type the tricresyl phosphate (E component) benzotriazol of a carbon number 7, and derivative; — benzotriazol (F component) alkyl succinic-acid derivative; shown by-izing 7 — R14 is the alkyl group of a carbon number 12, and R15 is the alkyl succinic-acid derivative [0048] of the alkyl group of a carbon number 5. (The evaluation approach)

** The evaluation approach of oxidation stability <a sludge examination method>; it is based on the trial based on the oxidation stability test enacted by JISK2540 by one of the approaches which evaluates the antioxidant engine performance of a lubricating oil.

test condition: -- temperature; -- 170-degree-C time amount; -- evaluation approach <Noack of 12hr** vaporization -- law >; -- it is based on the vaporization trial enacted by JPI-5S-41-93 by one of the approaches which evaluates the vaporization of a lubricating oil.

** The lubricative evaluation approach <the shell walk examining method>; based on ASTMD2783, it carried out by one of the approaches which evaluates the lubricity of a lubricating oil, and the diameter of wear estimated lubricity.

試験条件：回転数 : 1 2 0 0 r p m

荷重 : 3 0 k g f

試験時間 : 3 0 m i n

試験温度 : 室温

** The evaluation approach of the corrosion stability to a metal; based on JISK2513, it carried out by one of the approaches which evaluates the lubricity of a lubricating oil, and extent of discoloration of a copper plate estimated the corrosion stability to a metal. Extent of discoloration is evaluated in 12 steps of 1a to 4c, and shows a result with most [extent / there is few extent of discoloration of 1a (corrosion stability is the best), and] (corrosion stability is the worst) extent of discoloration of 4c.

** The evaluation approach of rust-proofing nature; it carried out by the approach enacted to

JISK2510 by one of the approaches which evaluates the rust-proofing nature of a lubricating oil, and extent of rust estimated rust-proofing nature. It estimated "with rust" extent of rust "had no rust", and, in the case of "with rust", evaluating by the advanced three-stage cost slightness and whenever [inside].

[0049] It blended at a rate (mass %) of hanging up one to example 6 base oil, A component, B component, C component, D component, E component, and F component over a Table 1 upper case, and the lubricating oil for bearing was prepared. The various engine performance of these lubricating oils is evaluated, and the result is shown in the Table 1 lower berth.

[0050] It blended at a rate (mass %) of hanging up one to example of comparison 2 base oil, A component, B component, C component, D component, E component, and F component over a Table 2 upper case, and the lubricating oil for bearing was prepared. The various engine performance of these lubricating oils is evaluated, and the result is shown in the Table 2 lower berth.

[0051]

[1 of Table 1]

	実施例 1	実施例 2	実施例 3	実施例 4
基油 ① ② ③	○	○	○	○
動粘度 100°C mm ² / s	2. 321	2. 321	2. 321	2. 321
粘度指数	205	205	205	205
添加成分 (質量%)				
(A) アルキル化ジフェニルアミン		0. 15	0. 15	0. 15
(B) アルキル化フェニル-α-ナフチルアミン		0. 25	0. 25	0. 25
(C) フォスファイト			0. 15	0. 15
(D) トリクレジルフォスフェート				0. 80
(E) ベンゾトリアゾール				
(F) アルキルコハク酸エステル				
スラッジ試験	析出物なし	析出物なし	析出物なし	析出物なし
Noack 重量減量 (質量%)	23. 2	19. 1	15. 9	15. 9
潤滑性 摩耗径 (mm)	0. 40	0. 40	0. 40	0. 31
銅板腐食 (121°C × 3時間)				
防錆性 (人工海水)				

[0052]
[2 of Table 1]

	実施例 5	実施例 6
基油 ① ② ③	○	○
動粘度 (100℃) mm ² / s	2. 321	2. 915
粘度指数	205	170
添加成分 (質量%)		
(A) アルキル化ジフェニルアミン	0. 15	0. 15
(B) アルキル化フェニル-α-ナフチルアミン	0. 25	0. 25
(C) フオスファイト	0. 15	0. 15
(D) トリクレジルfosfate	0. 80	0. 80
(E) ベンゾトリアゾール	0. 004	0. 004
(F) アルキルコハク酸エステル	0. 04	0. 04
スラッジ試験	析出物なし	析出物なし
Noack 重量減量 (質量%)	15. 9	16. 2
潤滑性 摩耗径 (mm)	0. 31	0. 31
銅板腐食 (121℃ × 3時間)	1a	1a
防錆性 (人工海水)	錆なし	錆なし

[0053]

[Table 2]

	比較例 1	比較例 2
基油 ① ② ③	○	○
動粘度 (100°C) mm ² / s	2. 586	2. 586
粘度指数	86	86
添加成分 (質量%)		
(A) アルキル化ジフェニルアミン		0. 15
(B) アルキル化フェニル- <i>α</i> -ナフチルアミン		0. 25
(C) フオスファイト		0. 15
(D) トリクレジルfosfate		0. 80
(E) ベンゾトリアゾール		0. 004
(F) アルキルコハク酸エステル		0. 04
スラッジ試験	析出物あり	析出物あり
Noack 重量減量 (質量%)	34. 3	33. 8
潤滑性 摩耗径 (mm)	0. 67	0. 49
銅板腐食 (121°C × 3時間)		1a
防錆性 (人工海水)		錆なし

[Translation done.]